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## GENERAL OUTLINE OF TREATMENT. DEMONSTRATION OF SURGICAL METHODS USED FOR EXTREMITIES AND SPINE AND RESULTS

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Mrs. La Du, Superintendents of the Various Institutions, and Friends: We are certainly very glad to have you here this morning for various reasons. First, because we feel that we have something here that you are interested in, and, second, we feel that fortunately we are very well equipped to show you the type of treatment that we give for infantile paralysis.

Two nights ago we had members of the Ramsey County Medical Society here, and they saw what was really being done for infantile paralysis. I think the average doctor has the idea that all we have to do, after a child recovers from the acute stage of infantile paralysis, is to go to a brace shop, buy braces, put them on the child, and he will be able to walk around; that after a few years, if he gets crippled up again because the brace did not do much good, then you have a type of operation which cures him.

In infantile paralysis we have three definite phases: The acute stage, the stage of improvement, and the chronic stage.

**Acute Stage.** The orthopedic surgeon sees very few cases of infantile paralysis in the acute stage. Perhaps he should see more, but usually he does not see them until they reach the improving stage. In the acute stage as a rule it is the general physician who sees the child down with fever due to an acute inflammation in the spinal cord, in most cases resulting in paralysis and muscular atrophy.

After the acute stage has gone on for a few days, usually paralysis develops.

As soon as paralysis is noted, the child needs orthopedic treatment, he needs mechanical treatment, to prevent deformity. He should be placed in a comfortable position, his feet should be held at right angles, and the bedclothes should be so arranged as not to push the feet down in an unnatural position. An unsupported paralyzed foot in the acute stage would result in deformity.

The child should be kept quiet until a definite time is reached, and that definite time we feel is when you can touch the child's limbs, squeeze the legs, pinch them, and use a little force in pressing the legs or over the nerve trunks, without discomfort to the patient, or, in other words, when the tenderness has disappeared. Then we feel that the acute stage is over and the patient is ready for treatment in the next stage, the improving stage.

No manipulation is used in the acute stage, nothing but rest. Usually the child needs general treatment, such as tonics to stimulate his appetite—the appetite needs improving. He should be kept quiet and, above all, he should be kept warm. The acute stage may last only two



or three weeks, or it may be four or five months before the child is ready to receive any real treatment other than rest, as far as improving him is concerned.

**Improving Stage.** The next stage is the so-called improving stage.

We have no arbitrary limit as to how long the improving stage will last. It may be one, two, three or five years, but with proper care and with care in the use of muscles, the child will improve under proper conditions after the acute stage has passed, and will continue to improve year after year. The greatest good is done in the improving stage.

After the acute stage is over, you must have a checkup. You must know what muscles are paralyzed. You must know how badly they are paralyzed. I think you will see that demonstrated this afternoon.

After a child has passed the acute stage of infantile paralysis, he comes here. We want you to see the children early in the improving stage.

**Checkup.** The first thing we do is to check up. We go over every muscle in the whole body. We determine whether or not a muscle is completely paralyzed.

We say that the muscle is gone if it has lost all power.

If the contraction is very weak, we say that we have a trace.

Then we have the muscle that contracts when gravity is eliminated. That is called a poor muscle.

We have the muscle that will contract against gravity. That is called a fair muscle.

Then we have the muscle that will contract against gravity and some definite force. That is called a good muscle.

So we have a definite checkup, and we try to keep track of the improvement month by month by various checkups.

**Apparatus.** It is very gratifying to note that most of these children do improve very rapidly when muscles are put at rest, and they have certain types of treatment which we will describe. In the improving stage if a muscle is paralyzed, or partially paralyzed, or so weak it cannot work against gravity, or cannot work against gravity with some definite force, then it needs some type of apparatus to keep it from strain or from getting tired out. So we use various types of apparatus to keep the arms in a certain position and the feet at right angles so that certain muscles will be at rest.

**Fatigue.** In the improving stage the greatest damage that is done to the muscles weakened by infantile paralysis is brought about by too much fatigue. Fatigue is extremely detrimental.

A man who had had infantile paralysis said to me: "In the morning I feel fine. I can move my limbs, and they feel fairly strong, but by

the time they get through giving me my electric treatment and my massage—the masseur works on me for an hour and a half—I am tired out." He was getting too much treatment.

Too much fatigue must be guarded against.

**Muscle Training.** The most valuable type of treatment is that known as muscle training. Muscle training is the Christian Science of infantile paralysis. In other words, we ask the child to contract a certain muscle, and at the same time the physiotherapist works the limb in that direction. We are trying to get a nerve impulse from the brain of the child down to this muscle, to this damaged area. We are trying to get him to concentrate on what is being attempted. Muscle training requires not only the cooperation of the child but his closest attention, as well. By having him pay close attention to what is being done, we get his *cooperation.*

You will see muscle training demonstrated this afternoon, and you will realize how valuable it certainly is.

**Heat.** Heat is used in the treament of the improving stage. A warm muscle is capable of better function than a cold one. If your feet are cold, you cannot run a very good foot race. When a child has had infantile paralysis, his limbs become chilled, they are cold; the temperature is below normal, sometimes as low as 70 or 80 degrees. Many children come into the out-patient department with limbs actually frozen so that they have ulcers on the skin because they have not been kept warm. By chilling a paralyzed limb a superficial necrosis of the skin is easily produced.

We use types of simple apparatus, the most common type, radiant heat, being heat given off from the electric lamps. Hot water bags are also used, but electricity seems the easiest way. Moist heat is less desirable, as it macerates the skin, makes the skin tender, and cannot be borne at so high a temperature as can dry heat. Radiant heat is a dry heat and can be used for a long time.

In view of the fact that the muscles function better when warm, we are sure to see that the affected parts are kept as warm as possible by means of extra clothing.

**Massage and Manipulation.** Massage has not so great a place in the treatment of infantile paralysis as you might think. It does not bring power to a muscle except indirectly. It is used, first, to improve circulation; second, to restore heat; and, third, to soften muscles that have been hardened because of the fact that they have not been used.

**Hydrotherapy.** We give the same muscle training in the pool that we give on the table. This is called *hydrotherapy.* We have a child get into the pool and move his limbs. He also learns to float or swim.

The advantage of the pool is that gravity is eliminated. A child who cannot walk across the floor can tread across the pool. Gravity being eliminated, he can use muscles in the water that he could not use outside of it.



**Operations.** Simple operations are very frequently used, and are the only type that should be used in the improving stage; simple operations to correct deformity.

Sometimes we find that a child's limbs were held in poor position after the acute attack, and that deformity has developed. That condition should be taken care of before apparatus is applied.

**Electricity.** In the good old days electricity was used by the doctors for muscle stimulation. The patient placed one foot in a basin of water to which an electrode was applied, another electrode was applied to the muscle to be stimulated, and the current turned on. That type of treatment may be as effective as carrying around in the pocket the foot of a rabbit which was shot in a graveyard at midnight. It is no better.

Electricity can be used in the case of an adult by a trained neurologist, but with children it is practically impossible to use this kind of treatment. It is too painful. So we use no electricity so far as muscle stimulation is concerned.

**Physiotherapy.** Physiotherapy is used after the acute stage, and we keep it up sometimes for one year, and very frequently for at least two years if we can.

The advantage of physiotherapy is, first, that the child or individual gets the desire to get the best out of his injured members. He becomes interested. Instead of thinking, "I am going to have a paralyzed arm; it is useless to do anything," he does his best to get all he can out of his paralyzed limb or member. Instead of being satisfied with his condition, he gets a desire to recover. He wants to become a useful citizen again.

In adults it is also educational to have this re-creation through certain types of work that they do for certain paralyzed muscles, a type of training to educate these muscles.

It is an educational process for the children also. They become interested, and good habits are formed.

**Surgical Stage.** Usually we say that the surgical stage arrives about two years after the acute onset; that is, after the child has had the use of apparatus, has had training, has been cared for, and his limbs show no return to their former condition and the muscles show no return to their former power, then we do certain surgical procedures to help the child so that the use of braces will no longer be required.

The difference in the use of braces has been very marked in the last few years. We do not use nearly so many as we used to. As a matter of fact, surgery has taken the place of a great many of the braces. Braces are now put under the skin. Such braces have the advantage of not wearing out, and they are better than braces on the outside.

**Bone Operations.** We have certain types of operations which are used in the surgical stage, which begins usually two years after the acute stage. The first is osteotomy, the surgical cutting of a bone for

the purpose of overcoming deformity. We may do fusions of bone. We may cause a bone to become stiff over a joint by taking a piece of bone from one part of the body and attaching it to the joint. We may remould a bone or even change the shape of it to overcome deformity. We make a joint stiff or stop at a certain angle. This takes the place of a brace.

**Tendon Operations.** We have operations on the tendons to improve or restore the muscular balance, or it may be to correct a deformity. There may be tendon transference so that a flexor muscle takes the place of an extensor. A tendon may be transferred from one part of the body where its removal will not cause disability to some other part where it will be more useful.

Years ago we used to make ligaments out of tendons. Some operations very much in favor ten years ago have practically disappeared. Operations today are very much more simple than those used in former times. We use practically no foreign material any more. We formerly used nails, silk, wire and other apparatus to make joints stiff and to hold them, but practically all that type of operative procedure has been discarded because unsatisfactory.

We have operations on muscles to lengthen them or perhaps transfer a large portion of one muscle into another muscle to get contractions.

This morning I am going to show you just a few of the more simple procedures that are used for the upper extremities and the spine. We have a few of the children that we can use in demonstrating this type of condition.

**Case 1.** This young man has had an infantile paralysis affecting both lower limbs. As you see, it is necessary for him to wear long leg braces. He came in unable to walk without assistance. Even with assistance he walked with his knees flexed and his legs dangling along. He walks very well now, and will improve so much that braces on the lower extremities will not be necessary.

He also has another condition in the upper extremities; he has complete paralysis of the deltoid muscle. The deltoid muscle rotates the humerus—this bone between the shoulder and the elbow—inward. He just cannot lift his arm. This has been going on for a long time, about four years now, I believe. He has had no return to power in this muscle.

Through surgery we have a way of making the muscles of the shoulder take the place of the deltoid muscle, thus helping the patient's arm so that he can put it in certain positions. The muscles that control the scapula, this flat triangular bone behind the shoulder, are very strong. He has good power to "shimmy" his shoulder. If he had his arm fixed in this position, about 70 degrees up from his body, and the humerus attached to the scapula, he would have an arm that he could put to his head or his shoulder, and he could feed himself with it. The only disadvantage would be that he could not get his arm behind his body.



This is the type of case where the shoulder is made stiff by partially dividing the acromion and placing it in a groove prepared for it in the humerus, and suturing the head of the bone to the acromion, glenoid and base of the coracoid. Because of his ability to use his scapula well, he gets very good motion in his arm.

I might say that this shows that paralysis of the upper extremities does not compare so far as serious results are concerned with paralysis of the lower extremities. We do not have to walk with our arms. If we have good biceps we can flex and supinate the forearm. If the shoulder joint has been completely destroyed and the humerus has been allowed to grow on the scapula at an angle of approximately 70 degrees, then the patient has all the motions that go with the scapula, which gives him very good results.

**Case 2.** Occasionally we have paralysis of the biceps muscle in the upper extremities; that is, the child is not able to flex the elbow, but does have good muscles of the forearm. Now, we have found that by using certain of the muscles of the forearm and transferring them up onto the shaft of the humerus a little higher, instead of being flexors of the hand, they become flexors of the elbow.

This young lady has had this done. The muscles attached to the olecranon, this curved process from the ulna at the elbow, were moved up two inches or so onto the humerus. Now she has the power to flex her elbow by using the flexors of her wrist or hand; that is, she has no biceps muscles, but through the use of the transplanted muscles of the forearm, moving the muscles very hard, she has a flexor of the elbow, so that she can use her arm very well.

The motions of the hand are so fine and so complicated that tendon transference in the hand is not very satisfactory as a rule, but occasionally it is done. I mean, sometimes when we have a stronger flexor of the wrist, we can use it on certain muscles of the hand. This young lady has the type which is sometimes very satisfactory. She has paralysis of the small muscle of the hand. Very frequently we can take the muscle of the wrist and attach it to the thumb and make a thumb adductor. That is one of the satisfactory operations in the hand so far as tendon transference is concerned. Some of the other operations are not very common. It is strange how well an individual will use the hand even though certain muscles are lacking.

Transference of the flexor muscles of the forearm to the upper arm is a very satisfactory operation.

This young lady also has an involvement of an upper extremity. With very little effort I can dislocate this shoulder. She has no deltoid muscle; it is paralyzed. She is contemplating having arthrodesis of the right shoulder, an operation whereby if the shoulder is placed in this position she can feed herself, comb her hair, and do things she cannot do now. She has no deltoid. We can feel this shoulder slide out and in. It is flail; it is dislocated. By fixing it in this position we will have all the motions the scapula gives her.

**Case 3.** This again is an operation whereby the shoulder has become fixed to the scapula. It gives her a very satisfactory result. She has very good power in the muscles that control the scapula. She can feed herself and uses her arm very well.

(Question: Dr. Chatterton, is there enough flexibility in the scapula so that the arm will shove against the body?

Answer: Yes; it will drop down practically straight.)

**Case 4.** Occasionally we have an individual who has a dislocation of the hip because of absence of muscles around the hip. There are several ways of taking care of this situation, but we have thought that exterior articular fusion—that is, making the hip stiff from the outside—would hold the hip in position. If we would put a piece of bone taken from another portion of the body and allow it to grow across from the ilium to the trochanter major, it would become solid and would keep the hip in place. Also, that if we wanted to take a good sized slice of the ilium, roughen the surface, drive it into the trochanter major, and allow it to grow across from the ilium to the femur, it would form a piece of bone across the joint and make the hip stiff.

With this young man we first tried to make a big, high roof above the socket, expecting that would hold him, but inasmuch as he had no muscles it simply slipped out, so we had to partially fuse his hip.

**X-Ray.** This shows where the shaft of trochanter major gives him a stable hip. It is much better than one that used to slip out and was constantly getting shorter.

**X-Ray.** Here is where a slice of the ilium was used to make the hip stiff. It did not happen to be for infantile paralysis, but the principle is the same. The muscles were slipped out of the way, a large piece of ilium, about two inches wide, was pried loose and driven into the trochanter major, the tissues slipped across, and it made the hip stiff. You can see a large piece of bone in the trochanter major. It gradually becomes solid and stabilizes the hip.

This happens to be the type of cast which is sometimes used, either like this or down both ways. It is sometimes used after this operation.

**X-Ray.** Here is where an outside graft was made. A piece of bone from another portion of the body has been inserted at the head of the femur into the ilium, which makes a large piece of bone across the joint.

**X-Ray.** Here is one that was taken a long time after the operation. You can see what a firm, strong piece of bone it gets to be after a while. It holds the hip perfectly stiff.

**Case 5.** Of all the deformities that we have, curvature of the spine is one of the most difficult to treat. Whether it is due to infantile paralysis or whether it is due to a rachitic condition, or whether it is due to an unknown condition, a deformity of the spine is very difficult, because you have a chest that is moving, and it is not easy to apply pressure to it.



One of the principles of orthopedic surgery is that in order to correct a deformity, you must over-correct it at first. It would be very difficult to unwind this young lady and put her in the opposite position.

In infantile paralysis we have a great deal of trouble with curvature of the spine. This is due to the fact that we have a stronger muscle on one side of the spine than we have on the opposite side.

If this young lady had had infantile paralysis, the strong muscle would be on this side and would pull her down so that the deformity would begin to bulge out and we would have this marked curve.

We do all we can to develop muscles. We do as much as possible to get them back. We place a spine muscle in the best possible position, hold it there with apparatus, and keep it there for a long time. In spite of apparatus, the muscle always wins if strong. In spite of the best apparatus we can put on—it is very uncomfortable to wear—the deformity goes on and increases. This is true in all types of curvatures, especially when they get as bad as this young lady happens to be. That is why curvature of the spine is so difficult. To overcome this we have tried to make the spine stable. A little bit later we will speak about trying to make the spine stable by putting a piece of bone or extra support along the side. If we had given this young lady no treatment, she would have kept on going down until the ribs dropped down into the pelvis. When the ribs rest in the pelvis, one cannot become much more deformed. If we should just let her go, this is where deformity would result. You see what she can do all by herself. That is through muscle training. She can almost over-correct her deformity. If she should keep on getting worse, then some more severe treatment might be thought of.

Another difficulty is the fact that you cannot put on apparatus that will hold the spine any too well. In the high dorsal region especially it is very difficult.

**Case 6.** Here is a young lady who had infantile paralysis. You can see what difficulty she has in trying to sit up.

Early in the paralysis, curvatures of the spine are not very apparent. They just suddenly go down all at once and curvature appears. When curvature does begin to show very much, it develops very rapidly.

Here is a young lady who does not look so very bad on the outside, but when we get her x-ray picture, she has a very bad deformity. This is going to increase if she does not have support, something to hold her, up to a certain time. That time is when her ribs are resting down in her pelvis. Then she will not become much more deformed.

This young lady should have a certain type of exercise. She should be treated to develop all the muscles she can so as to get in the very best position possible. Then if we cannot keep her there, we will perhaps do surgery. She is older. Sometimes the older individuals, by working with them and keeping on support, do not tend to change very much. Younger children change a great deal, even in spite of surgery.

**Case 7.** This is another case of curvature of the spine.

Sometimes the patients have very bad curves. We work with the

individual curves and straighten them all we can. We get the muscles in the very best condition possible. Then we put the patients in plaster and hold them in the very best possible position. That is one method.

Then we operate. With the back in the very best possible position we put in an extra piece of bone to stiffen or stabilize the most deformed part of the spine. We start where the spine is fairly normal, where there is still muscle, and develop or build it up through one or two operations for stabilizing the spine. With the large bone graft becoming firm and hard and holding the spine in the best possible position, the patient will be able some day to stand up without having the spine drop to one side.

This young lady, instead of having a deformity such as she now has, which is very marked, will at least be up so that her ribs are out of her pelvis. She will be able to breathe normally, and will develop much more than she would if she were allowed to go on as she is, and her ribs were permitted to drop down into her pelvis and deform her chest and displace her internal organs.

**X-Ray.** You can see the bone graft which has been put in her back, a long, thin piece of bone which is inserted along the side of the spine.

Case 8. This young lady's operation is only two weeks old. She was treated in the same way as the preceding patient, being placed in the very best possible position when plaster was put on her. Then her spine was fixed.

She has the same style of brace the other girl was wearing, which holds her limb straight and keeps it in the best possible position.

Case 9. This young lady has had the operation done on her shoulder, where the humerus has been fixed to the scapula. She also had paralysis of her forearm. She has no biceps at all. She has had the muscles of her forearm transferred up two inches onto the lower end of the humerus, so that she has good power this way. Her arm will even straighten out after a time. She had a dangling arm before.

Her shoulder does not seem so strong today. The last time I saw her it seems to me she was doing everything with it. Today she won't do anything. Instead of having a dangling, loose arm, it will be straight and will have good power.

**X-Ray.** This is her photograph, taken after the operation. It shows the arm that hung to her side and was worthless. She will develop a great deal of motion in her shoulder. She can do quite a good deal with her scapula. She ought to do more.

**Mrs. La Du:** We certainly want to thank you, Dr. Chatterton, for this very interesting and instructive presentation of what you are doing for infantile paralysis cases. I am sure we will all feel that we know a great deal more about it after having listened to your discussion of the subject.

The next subject in our symposium this morning will be by Dr. Williamson, also a member of the hospital staff. He is going to show us the "Apparatus as Used Pre-ambulatory."



## APPARATUS AS USED PRE-AMBULATORY

G. A. Williamson, M.D., St. Paul, Minn.

Mrs. La Du, Superintendents of State Institutions, Ladies and Gentlemen: The treatment of poliomyelitis dates back to about 1840, when a German physician by the name of Von Heine wrote for us a scientific description of the disease and recommended certain principles of treatment. He was the first to recommend the use of braces, the use of massage, the use of heat, and the use of certain exercises. Since that time we have been doing more and more along the lines of massage and muscle training and exercises and with braces for the support of these paralyzed extremities.

The phase of treatment to be considered extends over a period of about two years, the first six months being the most important. After that one may expect to find a general, more gradual improvement for a period of about two years.

The cases we admit to this institution come in about six weeks after the initial illness. The first stage of the treatment is a muscle test, which is an evaluation of muscle power in each voluntary muscle in the body, with special attention to the paralyzed extremity. After the muscle test is made, one has a definite record of which muscles are paralyzed and the relative degree of paralysis. Then you can direct your attention primarily to the muscles needing the most active treatment.

Most of our cases are put to bed and are kept in the prone position for about six months. Muscle tests are repeated at intervals so that the power of various muscles can be watched, gradual improvement or lack of improvement determined, and the questions of further treatment in bed or getting the patient up on his or her feet decided.

I have a number of cases here that I desire to present to you as examples of the initial stages of treatment; that is, the treatment in bed with proper splinting.

Poliomyelitis is a great catastrophe to the nervous system. The acute inflammatory reaction which takes place in and around the motor cells of the spinal cord has a very damaging effect on the nerve cells, and may lead to impairment, to a greater or lesser degree, of the motor function in certain cells controlling the action of the muscles. The degeneration of the nerve cell which takes place as a result of the inflammatory process may be a partial one leading to temporary loss of function or a total one leading to permanent loss of function.

An important requirement in treatment is complete physiological rest of the patient; that is, rest in bed, with careful attention paid to prevention of fatigue and to the proper nourishment of the body. Fatigue is a factor very detrimental to the recovery of power in the weakened or paralyzed muscles.

By evaluation of the muscle power, we have determined which muscles are weakened or paralyzed, and, therefore, which muscles need